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Occupation and income related to psychometric *g*

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Abstract

The regressions of occupational status and income on psychometric *g* factor scores were examined in large samples of White (W) and Black (B) American armed forces veterans in their late 30s and who are fairly representative of the population of employed W and B males. These results indicate that when Bs and Ws are matched on *g* scores, there is no evidence of discrimination unfavorable to Bs for job status at any level of *g*. Nor are Bs with the same *g* scores as Ws disadvantaged in income when they are above the median level of *g* in the total sample. In fact, on both variables — job status and income — Ws turn out to be the relatively more disadvantaged group when the level of *g* is taken into account.

Keywords: Intelligence; Race; Income; Occupational status; *g* factor

1. Introduction

One of the clearest items of evidence that the general factor in a battery of diverse mental ability tests, or psychometric *g*, has important "real-life" correlates is the relationship of *g* factor scores (or of scores on any highly *g*-loaded tests) with occupational status and with income (Burt, 1943; Gottfredson, 1986, 1997; Herrnstein & Murray, 1994; Jencks, 1972, 1979; Jensen, 1980, 1998; Mackintosh, 1998). The present study extends examination of the relationship between *g* and job status and income to the study of group differences in these variables. Previous predictive models of group differences in income (Brown & Reynolds, 1975; Cattell, 1983) have assumed equal regressions of the compared groups' income on IQ scores. The present study examines this assumption for both job status and income, based on

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large data sets of Black (B) and White (W) American males. All the cited models of group differences in income in relation to group differences in IQ were based on and tested on data obtained before the advent of Affirmative Action policies (instituted in the mid-1960s) became widespread after about 1975.

In an essay on the average income disparity between B and W Americans, its authors state: "The disparity between black and white incomes has been a central problem of American public life for decades. Although the gap is smaller than it was a generation ago, progress has been slow and fitful, leading many to doubt whether true parity can be achieved without substantial government intervention in the labor market. . .. In previous work, we have shown that the disparity in hourly pay between young blacks and whites can largely be traced to a gap in basic skills that predates their entry into the labor market. . . this skill deficit explains most of the racial difference in wage outcomes among young adults" (Johnson & Neal, 1998, p. 480).

It has been demonstrated elsewhere that what these authors refer to as "a gap in basic skills" can be viewed much more generally in terms of "Spearman's hypothesis" of a statistical or distributional difference between B and W populations on all psychometric tests to the degree that such tests are loaded on the *g* factor, which is common to all cognitive tests (Jensen, 1998, chapter 11). Our aim is to examine B–W differences in occupational levels and in income in relation to factor scores for *g* (i.e., a *g*-weighted average of 19 independent diverse cognitive and psychomotor ability measurements). Although the research literature has innumerable comparisons of different racial groups in mean income and job level and the simple correlations of these variables with IQ, previous studies have not examined group differences in the form of the regression of income and job level on psychometric *g*, the main component of IQ tests' predictive validity.

2. Method

2.1. Subjects

The Centers for Disease Control (CDC, 1988) provided an archival data set on 4462 males who had served in the United States Armed Forces. The percentages of Ws and Bs are 87% and 13%, which are almost exactly the percentages in the total United States population. The percentages of draftees and enlisted men are 62% and 38%, respectively, for Ws, and 67% and 33% for Bs; in the total sample, 67% were drafted. Approximately half of the sample had served in the Vietnam War. The CDC's original purpose in obtaining these data was to assess the long-term effects of the veterans' military service some 17 to 18 years after induction in the military. The total sample is fairly representative of the U.S. population in race, education, income, and occupations. However, it should be noted that a mandate of the U.S. Congress excludes from military service all persons who score below the 10th percentile of national norms on a preinduction general aptitude test. Therefore, the lower tail of the distribution of ability is somewhat truncated in this sample, with a relatively stronger effect on the lower scoring subgroups in the population, thereby underestimating to some undetermined degree the differences between various subgroups' mean scores in the total U.S. population on some of the psychometric tests and hence on the *g* factor scores as well as on the *g*-correlated variables in this study, viz., years of education, occupational status, and total annual income. There was no formal truncation at the top end of the scale. Self-selection and various other educational and social selective factors affecting enlistment or draft status might possibly result in some degree of underrepresentation of the potentially higher scoring individuals, but we have no information on this.

The two population subgroups selected from the total sample for the present study are (1) all of the non-Hispanic Whites (W) and (2) African Americans, or Blacks (B), for which there was complete data on each of the variables in the study. The sample sizes are W ($N=3484$), B ($N=493$). The subjects' average age on entering the service in 1967 was 19.9 years (S.D. 1.7); the average age at which they were tested by the CDC was 37.4 years (S.D. 2.5). Both of the average age differences between the W and B samples are less than 2 months.

2.2. Psychometric variables

The psychometric battery consists of 19 experimentally independent variables that are highly diverse in the types of abilities, information content, and cognitive skills called for. Five of the tests were administered at the time the subjects were inducted into the armed forces; all the others were administered approximately 17 years after induction, on average. The battery includes measures of visual–spatial ability (block designs, figure copying, and immediate and delayed memory for copied figures, and pattern recognition), verbal reasoning, general information, concept formation (Wisconsin Card Sorting), wide-range achievement, verbal learning and verbal, arithmetic reasoning memory, vocabulary, reading comprehension, mathematics knowledge, and motor speed and dexterity. The specific tests and scores are described in Appendix A.

Three principal components were extracted (PC1 — general factor (g), PC2 — visual–spatial memory, and PC3 — motor speed and dexterity).

The g factor scores used in the present study are based on the PC1, as only principal components yield factor scores for a given component that are perfectly uncorrelated with those derived from any other component. PC1 accounted for 44.6% of the total variance in the 19 tests. The PC1 loadings ranged from $+0.363$ to $+0.856$, with a median loading of $+0.697$.

2.3. Education, occupation, income

Preceding the medical and psychological examination in 1985/86, subjects were interviewed for information on these variables, which are therefore based on self-report.

2.3.1. Education

This was recorded as total number of years of formal schooling, including college and postgraduate study.

2.3.2. Income

Each subject's reported "total household income for calendar year preceding the interview" was categorized by the CDC into one of the seven income brackets; the midpoints of each of the seven income intervals, reported in thousands (US$2.5, $7.5, $15, $25, $35, $45, $65), were used in the statistical analyses.

2.3.3. Occupational status

A subject's reported job description was classified by the interviewer according to the three-digit code for occupations used by the U.S. Census (Classified Index, 1982). The Index ranks (from top down) 503 separate occupations that were grouped in categories that included similar occupations. The ranking roughly reflects a composite of typical requirements for education, complexity of the job's cognitive demands, responsibility entailed, and typical salary. The 503 rank-ordered job descriptions were spread over a scale of 1000 index numbers in order to leave blank spaces for the future insertion of previously unclassified jobs without having to renumber the existing jobs. (We have reflected the Index's numerical ranks to 1000 minus rank order, so that higher status occupations are represented by larger numbers. The ranking, although reversed by this procedure, remains identical to that of the U.S. Census Classified Index.) Hence, typical high-status occupations (above 900) are top-level managerial and professional workers (chief executives, scientists, mathematicians, engineers, physicians, lawyers, etc.). Typical low-status occupations (below 150) are semiskilled and unskilled laborers (construction and production helpers, freight handlers, baggers, hand packers, garbage collectors, and vehicle washers). Interviewers' occasional errors in assignment of the Census Index jobs status code numbers from the subjects' actual verbatim job descriptions were corrected for use in a previous study.[1]

3. Results

Prior to all analyses, the psychometric data were statistically adjusted (by regression) for subjects' age differences and for test–retest interval. Similarly, all of the nonpsychometric variables were statistically adjusted for subjects' age differences. The general factor (g) of the battery of 19 psychometric variables is represented by the first principal component (PC1).[2] Factor scores on g, based on the entire combined samples (with $N=4462$), were obtained for every subject in the present study sample. In the following analyses, the g factor scores are expressed as percentile ranks. Table 1 shows the percentages of the W and B samples that fall into each 10-percentile interval of the g factor score distribution.

3.1. Descriptive statistics

Table 2 shows the mean and S.D. of each of the study variables for Ws and Bs and the effect size (d) of the W−B difference on each variable. The d expresses the mean difference in units of the average standard deviation (i.e., the square root of the N-weighted

[1] We are grateful to Dr. James M. Dabbs (Georgia State University) for providing these corrected job classifications.

[2] The characteristics of the Black–White differences per se in the factors extracted from the test battery used in the present study have been described in detail elsewhere (Nyborg & Jensen, 2000).

Table 1
Percentage of Whites and Blacks within each interval (in percentiles for total sample) of *g* factor scores

Percentile of *g* factor scores[a]										
Group	10	20	30	40	50	60	70	80	90	100
White	5.9	6.4	9.1	11.4	7.2	12.6	11.7	12.1	9.2	14.3
Black	33.9	18.7	19.3	12.3	4.6	3.8	3.6	1.8	1.8	0.2

[a] The indicated percentiles represent the upper limit of each interval.

mean of the variances within each group). Although all of the values of d are statistically significant, they differ greatly. Most relevant to the subsequent analysis is the marked contrast between the large value of $d = 1.30$ for *g* factor scores and the small value of $d = 0.16$ for years of education.

The Pearson correlation (r) and the Spearman rank-order correlation (r_s) between the key variables are shown in Table 3 for each group and for the combined groups. The values of r and r_s are highly similar, indicating quite regular distributions of the variables and minimal distortion of the correlations by outliers. Also, the W and B samples show similar correlations. The first principal factor extracted from the matrix of correlations among the four variables is virtually identical across the W and B samples, with a congruence coefficient of +0.999 and a value of $r_s = +1.00$. The magnitudes of the correlations are typical of those reported in the literature for these variables in samples of similar age (Mackintosh, 1998, pp. 50–53). The same is true of the partial correlations, shown in Table 4, statistically holding constant either *g* factor scores or years of education.

3.2. Regression of occupational status on g percentiles

In this study, regression reveals a more meaningful and important phenomenon than does mere correlation. The Job Status Index has a quite linear regression on *g* score percentiles in both the B and W samples, as shown in Fig. 1. The only salient deviation from linearity is for Bs in the top tenth of the overall distribution of *g* factor scores. But what is more interesting is that the regression line for Bs is above that for Ws throughout the full range of *g* factor scores and has a steeper slope. The regression equation of Job Status Index (JSI) on *g* percentile (*g*%ile) for Ws is JSI = 274.46 + 4.11 (*g*%ile); for Bs, JSI = 276.13 + 5.62 (*g*%ile). The difference in intercepts is nonsignificant, but the difference in slopes is significant ($t = 2.35$,

Table 2
Mean and S.D. of *g* factor score, years of education, income, and occupational index for Whites and Blacks and W–B effect size (d) for each variable

	White		Black		Effect
Variable	Mean	S.D.	Mean	S.D.	size d
g Score	+0.18	0.93	−1.01	0.82	1.30
Education (years)	13.35	2.34	12.99	1.94	0.16
Income (in 1985 US$)	30,052	14,137	23,215	14,467	0.48
Occupational index	526.1	309.5	439.8	301.8	0.28

All the values of d are significantly greater than zero (two-tailed $P < .02$).

Table 3
Correlations (Pearson r and Spearman rank-order r_s) between g scores, education, income, and occupational index in White, Black, and combined samples

	White		Black		Combined	
Correlated variables	r	r_s	r	r_s	r	r_s
$g \times$ Education	.59	.60	.41	.41	.55	.56
$g \times$ Income	.36	.35	.37	.34	.39	.38
$g \times$ Occupation	.38	.37	.31	.29	.37	.37
Education × Income	.36	.35	.33	.31	.36	.35
Education × Occupation	.45	.46	.41	.39	.45	.46
Income × Occupation	.37	.36	.31	.31	.37	.36

All the above values of r and r_s are significant (two-tailed $P < .005$).

$P < .05$). The B/W ratio of the rate of gain in job status with increasing level of g is 5.62/4.11 = 1.37; that is, Bs gain, on average, 37% more in job status from their standing on g than do Ws with the same level of g.

3.3. Regression of income on g percentiles

Like job status, total income has a linear regression on g-score percentiles for both Ws and Bs, as seen in Fig. 2. Unlike the regressions for job status, however, the W and B regression lines for income not only have significantly different slopes ($t = 3.60$, $P < .01$), but they cross each other at the 40th percentile, above which the B income increasingly exceeds the W income as the g score percentile increases. The regression equation in the W sample is income in US$=$18,930.47+$181.32 ($g$%ile). In the B sample, income is US$=$15,301+$276.95 ($g$%ile). Above the 40th percentile of the total sample, the ratio of Bs' rate of gain in income to the Ws' gains for each additional percentile point rise in g score is an advantage for Bs of US$276.95/US$181.32=$1.53/year per g%ile point above the 40th. The reverse trend prevails for Bs with g scores below the 40th percentile and Bs are disadvantaged, relative to Ws, losing $0.65/year per g%ile point below the 40th. However, in the present study sample the overall average income of Bs is only 77% that of Ws, given that in the total study sample 84.2% of Bs are below the 40th percentile of g scores compared to 32.8% of Ws, and 67.2% of Ws are above the 40th percentile compared to 15.8% of Bs.

Table 4
Partial correlations, controlling g factor scores and education (years)

		Partial correlation	
Correlated variables	Controlled variable	White	Black
Education × Income	g	.196	.210
$g \times$ Income	Education	.196	.273
Education × Occupation	g	.302	.326
$g \times$ Occupation	Education	.159	.171
Occupation × Income	g	.226	.221
Occupation × Income	Education	.250	.203

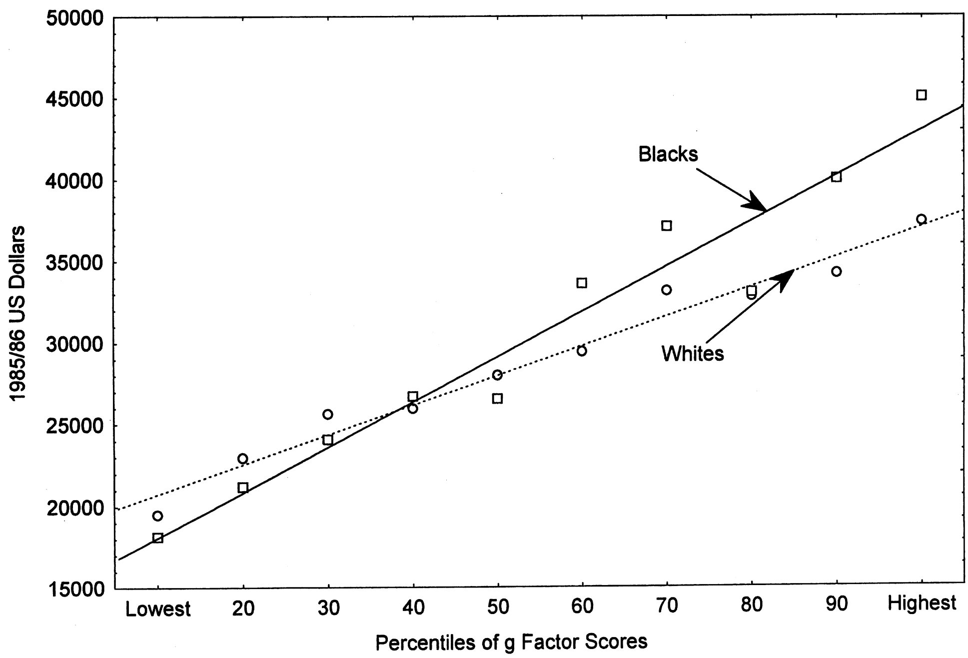

Fig. 1. The regression of the job status index on percentile rank of *g* factor scores in the Black and White samples.

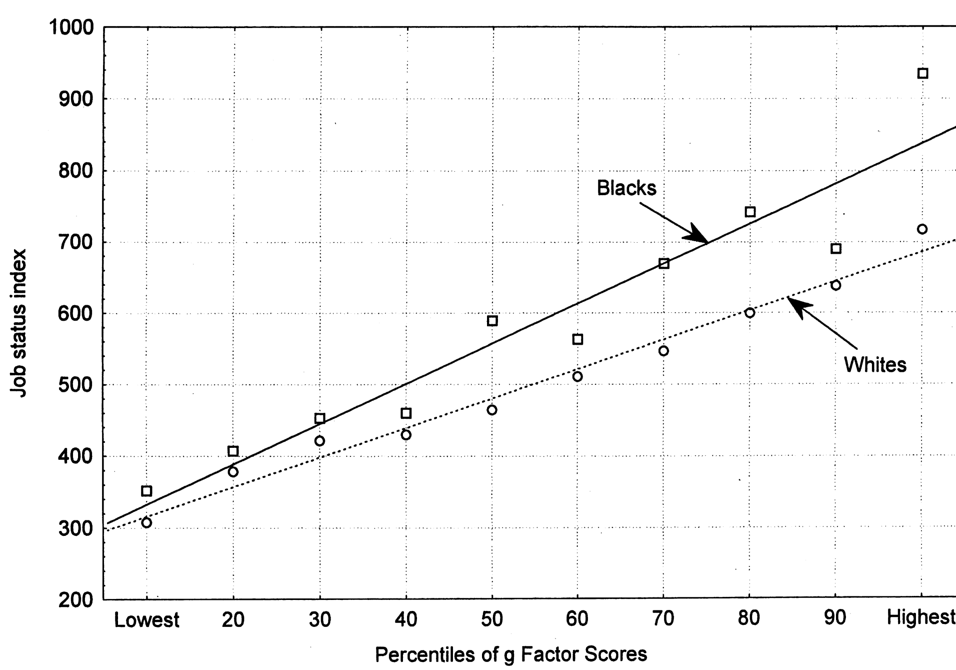

Fig. 2. The regression of annual income (in 1985–1986 US dollars) on percentile rank of *g* factor scores in the Black and White samples.

4. Discussion

Interpretation of the novel findings on the W–B differences in the regression of job status and income on *g* factor scores, shown in Figs. 1 and 2, is necessarily conjectural in the absence of other relevant data on the same samples that could be used to test specific explanatory hypotheses. However, our results are fairly consistent with certain findings of the only other study of comparable size, based on the National Longitudinal Study of Youth (NLSY) (Johnson & Neal, 1998). Although the NLSY data show that Bs with a college degree have a larger income than Ws with the same educational credentials, the income of Bs was still less than that of Ws when the groups were matched on the Armed Forces Qualification Test (AFQT). However, the slopes of the W and B regressions of income on the AFQT scores were not compared, as they were in the present study. This is the only standard method of analysis that could have revealed the present findings.

Using a considerably broader measure of *g* in the present study than was used in the NLSY study, and using a sample of somewhat older subjects with a longer work history more nearly approaching the asymptote of their career lines, we found that at every 10th percentile level of *g*, the mean job status index of Bs exceeds that of Ws who have the same *g* score. This finding seems most easily explained as an effect of "affirmative action," both in amount of education, especially beyond high school (which is related to job status) and in racially preferential employment policies.

For Bs above the 50th percentile of *g* scores, a similar interpretation can be made of the results for income, shown in Fig. 2. The B–W difference in the slopes of income on *g*-score percentiles can be likened to the supply and demand principle of economics: The relative scarcity of Bs at increasingly higher levels of *g*, along with the increased demand for Bs in higher level occupations (which typically make greater *g* demands), gives Bs a competitive advantage in the job market, especially for the higher status jobs. Cattell (1983) suggested a general model invoking supply/demand principles to explain the observed relationship between individual differences in ability and earnings. A more elaborate model relating income also to group differences in ability was proposed by economists Brown and Reynolds (1975) (for detailed explications of these models, see Jensen, 1998, pp. 564–569).

These models, however, can predict the results of the present study only if an additional variable is introduced, namely, a preference (and hence greater demand) for the higher-ability individuals from the group with the overall lower distribution of ability. Without taking account of this additional racial preference variable associated with affirmative action, the Cattell and the Brown–Reynolds models, which assume the same slope of the linear regression of income on *g*, would yield very poor fits to the present data. Relevant income/ability data obtained before 1975, however, are highly consistent with predictions from the Brown–Reynolds model. The model would now have to be modified in light of the present data. We can only surmise that this finding reflects one effect of affirmative action in the job market. The effects of affirmative action policies, instituted in the mid-1960s, gradually became more widespread. Gottfredson (1986) compared data sets from 1970 and 1980 on the job status of Bs and Ws in relation to their difference in IQ distribution. Although Gottfredson employed a very different analysis than we used, the picture it yields is fully consistent with the present finding, and more so for the 1980 than for the 1970 data. These data of the present study were obtained in 1985/86, when affirmative action practices in hiring and promotions were well under way. How or whether the B–W differences in the regression coefficients for job status and income might have changed since 1986 is not known, but this would be worth looking into, given suitable data. The data obtained in 1985/86 are nevertheless informative regarding the research question addressed here. Our findings, though based on data obtained 14 years ago, still will probably come as a surprise to many, in view of the popular belief that discrimination in job status and income unfavorable to Bs is based solely on race.

A feature of these data over which we had no control but is problematic for a definitive causal explanation of the results is that income was self-reported as the individual's total "household income" for the previous year rather than as that individual's own earned income. Earned income and total household income would be highly but not perfectly correlated and could differ to some degree between Bs and Ws, but it seems more likely that any such difference would merely attenuate the difference between the B and W regression coefficients rather than nullify or reverse it.

Below the 40th percentile of the *g* distribution, W incomes exceed B incomes, although by a relatively small amount. This could reflect a lesser demand for Bs relative to Ws in the less well-paid jobs, possibly due to Bs' lesser amount of previous work experience compared to Ws. It could also reflect Bs' working fewer days per year, on average, than Ws. Or it could be due to differences in the W/B rates of working overtime or taking moonlighting jobs. In fact, there is some independent evidence for each of these hypotheses (Johnson & Neal, 1998), and they all probably contribute to the observed effect. A definitive answer would have to come from other kinds of information that were not included in the present data set. Its sample sizes, however, are large enough to warrant full confidence that the phenomena reported here are true effects and are representative of the population of employed middle-aged Black and White males in 1986. The underclass, both Black and White, are scarcely represented in the present samples of armed services veterans.

Appendix A. Psychometric variables

1. Grooved Pegboard Test (GPT), (Right Hand): a measure of manual dexterity and fine motor speed; the speed score is the reciprocal of the number of seconds taken to place a set of pegs in a grooved hole as quickly as possible.
2. GPT, (Left Hand).
3. Paced Auditory Serial Addition Test (PASAT). A measure of mental control, mental speed, and computational and attentional abilities. The subject mentally adds a sequence of numbers in rapid succession; score is the total number of correct responses.
4. Rey–Osterrieth Complex Figure Drawing (CFD), direct copy score. A measure of visual–spatial ability and memory; the subject reproduces a complex spatial figure while the figure is in full view.
5. CFD, Copy from immediate recall.
6. CFD, Copy from delayed recall (20 min of other activities intervening).

7. Wechsler Adult Intelligence Scale-Revised (WAIS-R), general information, scaled score.

8. WAIS-R, block design, scaled score.

9. Word List Generation Test (WLGT). A measure of verbal fluency; subject generates as many words as possible for 60 s that begin with each of three letters: F, A, S. Total number of words generated.

10. Wisconsin Card Sort Test (WCST). A measure of concept-formation, problem-solving, and set-switching abilities and use of feedback in decision making. Ratio of correct responses to countable responses.

11. Wide Range Achievement Test (WRAT). Measures ability to read aloud a list of single words (untimed). Total raw score.

12. California Verbal Learning Test (CVLT). A measure of verbal learning and memory; subject recalls a list of 16 words over five repeated learning trials. Total correct over five trials.

13. Army Classification Battery (ACB), Verbal Test, administered at time of induction. A measure of verbal reasoning.

14. ACB, Verbal Test administered an average of 17 years after induction.

15. ACB, Arithmetic Reasoning Test, administered at time of induction.

16. ACB, Arithmetic Reasoning Test, administered an average of 17 years after induction.

17. Pattern Analysis Test (PAT). A visual spatial measure of pattern recognition, administered at induction.

18. General Information Test (GIT). Administered at time of induction.

19. Armed Forces Qualification Test (AFQT). A general aptitude battery; total score on four subtests (word knowledge, paragraph comprehension, arithmetic reasoning, mathematics knowledge). Administered at time of induction.

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